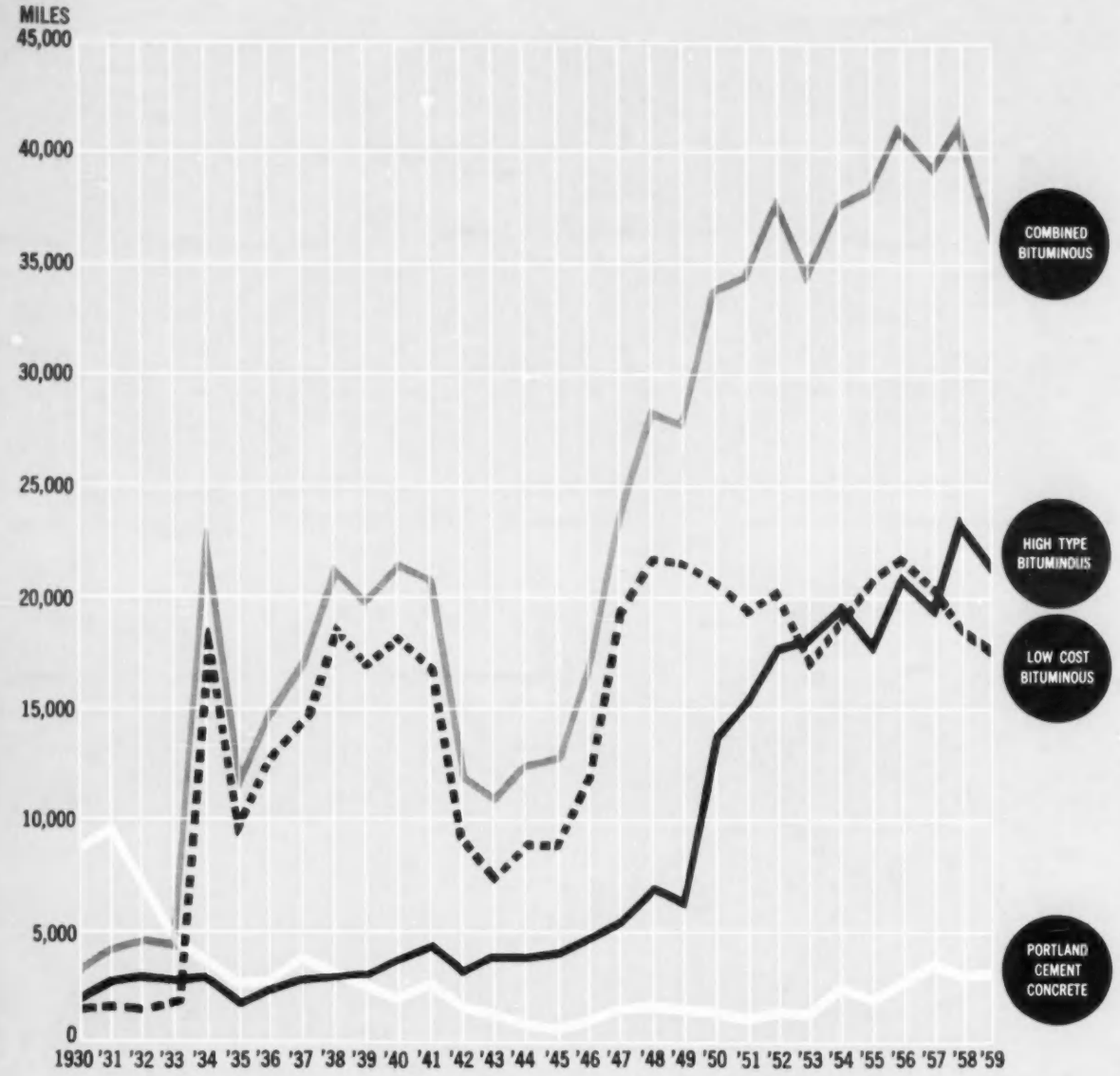
# ASPHALT INSTITUTE

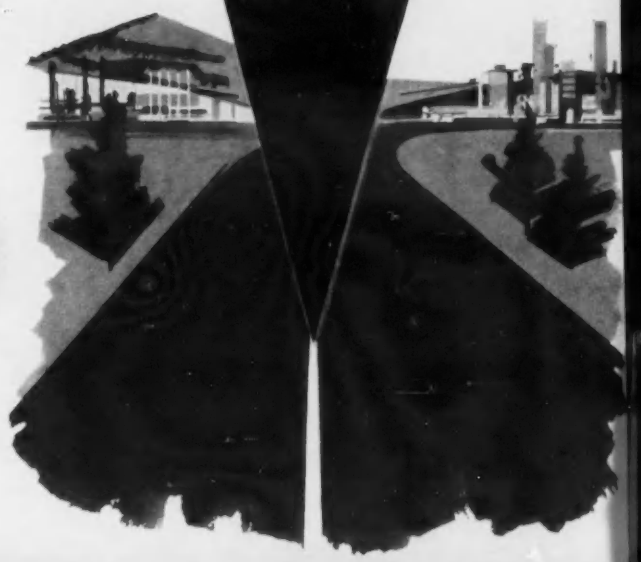
*Quarterly*

OCTOBER, 1961

In this issue: NEW JAPANESE EXPRESSWAY

# MILEAGE BUILT ANNUALLY BY STATE HIGHWAY DEPARTMENTS



*IN 1959, 84% OF ALL PAVED MILEAGE CONSTRUCTED BY STATE HIGHWAY DEPARTMENTS WAS SURFACED WITH ASPHALT*

CHARTED BY THE ASPHALT INSTITUTE

Source: U.S. Bureau of Public Roads *Tables SMB 1-5*

# ASPHALTOPICS

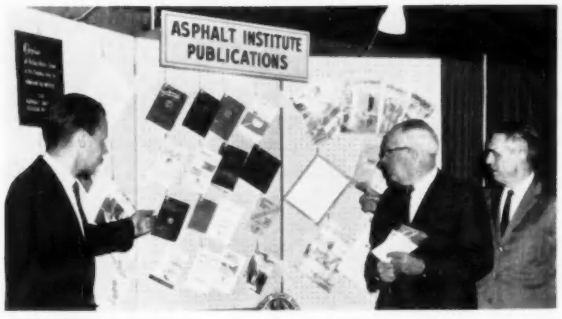
ASPHALT INSTITUTE Quarterly

LOSS LEADER—In our last issue, the artist threw in a supermarket register receipt for a touch of marginal color with our Lloyds Center (Portland, Ore.) story. This proved too great a challenge to Jack Wiley, a comparison shopper and human tabulating machine who lurks at the American Road Builders' Association. Jack promptly ran an audit on the grocery slip and hastened to point out that the $48.32 total was in error. Should have been $15.38. We have passed this information along to our artist who has changed grocery stores.

* * *

*We Cover (Part of) the Waterfront: Before we leave Portland, we want to tell you about the new gate for the world's largest grating dock being built for the Puget Sound Naval Shipyard. The gate is a huge steel box 176 feet long, 63 feet high and twenty feet thick. It will be ballasted with concrete and the weather deck will be surfaced with an inch and a half of asphalt concrete. The reason: to provide safer footing for workmen who will pass back and forth on it, and to help protect the metal deck from the elements.*

* * *




**Asphalt Institute contribution to the mid-summer highways exhibit in the Department of Commerce lobby was a display of Institute literature. Shown here are Commerce Secretary Luther Hodges and Federal Highway Administrator Rex Whitton, inspecting the Institute exhibit while Hugh Gillespie, Visual Aids Technician, looks on.**

*Continued on page 14*

## NEW INSTITUTE PUBLICATIONS

Maintenance of Asphalt Pavements (Information Series No. 117)—This handsome 24-page two-color brochure is a comprehensive treatment of the major ills of an asphalt pavement. Authored by W. L. Hindermann, Midwest Division Managing Engineer of The Asphalt Institute, this booklet offers step-by-step procedures for patching and making other surface repairs, describes methods and materials used in sealing cracks, and discusses the rehabilitation of old pavements.

Asphalt Base—Key to Better Pavement Performance (Information Series No. 118)—Another 16-page booklet written by Mr. Hindermann of The Asphalt Institute's field engineering staff. Includes a broad review of growing popularity of this construction here and abroad, laboratory data confirming its strength characteristics and a survey of the special engineering advantages of asphalt base. This is an engineering discussion for design engineers.

*Vol. 13, No. 4* *October, 1961*

**Glynn Harvey, *Editor***
**Bill Weeks, *Associate Editor***

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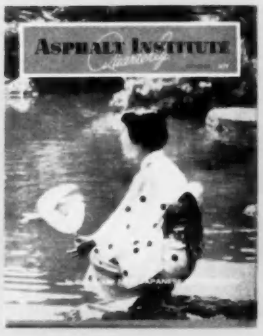
### Cover

**Completion of the Yamashina Project was the signal for the laboratory girls of the Japan Road Corporation to don the traditional kimono for a ceremonial party in the beautiful gardens of Kyoto.**

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**The member companies of the Institute, who have made possible the publication of this magazine, are listed on page 15.**

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*First Section of Japan's new port-to-port expressway built*

# THE YAMASHINA PROJECT

First lane of surface course. Outside lanes were paved in echelon, requiring only one cold longitudinal joint

The beauty of Japan is caught in this view of the paving-rolling sequence against scenic mountain backdrop

**The new expressway is carried across densely populated valleys on embankments which are pierced by numerous underpasses to avoid disrupting the established patterns of living.**

**by Albert Love**

JAPAN, with its many clear rivers and small streams, its majestic mountains and the unbelievable green of the rice paddies in the valleys, is one of the loveliest countries in the world.

But scenic beauty doesn't always go hand-in-hand with simplicity of highway building. And the best example of this is offered by the new Nagoya-Kobe Expressway which will relieve the congestion on the present highway facility between these two great ports.

## MOUNTAINS AND VALLEYS

Terrain on the expressway route varies widely and the design problems are multiplied accordingly. There are rivers to cross, rugged mountains to be bored, urban areas to be hurdled by viaduct and alluvial valleys where the road must be carried across on high embankments with closely spaced underpass structures to avoid disrupting the normal living pattern in these densely populated farming areas.

Because the clay which underlies the arable topsoil is very soft and deep, rigorous design problems are being encountered. In one 12-kilometer section, known as the Ogaki soft ground area, laboratory and field studies have shown that the embankment will settle from 1.0 to 1.5 meters. Here, sand piles and surcharge embankment loads are being used to accelerate consolidation of the foundation soil.

When completed in 1964, the expressway will be a modern toll road with twelve points of entry along its 188-kilometer length (approximately the same length as the New Jersey Turnpike.) It is a four-lane divided highway which embodies modern highway engineering concepts. Years of careful engineering analysis went into its location, and its geometric and structural design. With an eye not only to construction costs, but to anticipated maintenance charges, the Japan Road Corporation (Nihon Doro Kodan), its builders, wisely insisted on adequate design and quality construction and provided as much built-in maintenance as possible.

## ASPHALT CHOSEN

Pavement selected for this project (with the exception of the seven dual tunnels and bus-stop turnouts) was a dense

type hot-mix asphalt concrete designed for a dual wheel-load of eight metric tons and a tire pressure of eight kilograms per square meter.

Typical of the pavement design on the entire expressway, according to Chief Engineer Nobutaka Katahira, is that chosen for the initial paving job—the so-called Yamashina Project.

This 4.3-kilometer section lies on the by-pass which skirts the eastern edge of Kyoto, one-time capital of Japan and still the cultural and artistic center of the nation where the old way of life is carefully preserved. This section was let to contract early in the game as a test section to determine the adequacy of design and specifications and to test the ability of the Japanese contractors to produce quality work under relatively new requirements within tight time schedules. It served also for the training of engineers and inspectors.

Subbase material was a well-graded sandy gravel from the Yasu River to which a small amount of sandy silt was added in controlled proportions by mechanical feeders. These materials were plant-mixed at the source.

Base course material was a mixture of crushed stone, crushed over-size gravel scalped from subbase production, fine sand, and a select material containing some silt sizes. These four materials were blended in controlled proportions by mechanical feeders and mixed in a continuous twin-plug mixer with water for compaction added as necessary.

Subbase and Base course, twenty centimeters (7.87 inches) thick, were constructed in two layers of ten centimeters (3.94 inches) each, and a combination of pneumatic and steel-wheel rolling produced densities well above the specified minimum of 95 percent (Modified Proctor). The base was primed with an MC-1 cutback asphalt.

Central testing agency for the expressway was the Doro Kodan's laboratory at Kyoto, a large and fully equipped organization, adequately staffed. Job mix formulas for the binder course (using 60-80 penetration asphalt with a ¾-inch maximum size aggregate) and surface course (80-100 penetration asphalt and half-inch maximum size aggregate) were prepared in the lab. To check in-place densities and the placing, rolling and finishing characteristics of these mixes (and to provide a shake-down cruise for the new plant and inspector personnel), a test section was placed before actual paving operations were started.

Rains are so frequent in Japan that it was decided to begin placing the paving mixture on the high side of the transverse slope to facilitate drainage. The binder course—ten meters (32.8 feet) wide and six centimeters (2.36 inches) thick—was placed in three lanes: the first lane was placed to abut the concrete gutter edge and the other two lanes were laid with two spreaders operating in tandem. This required only one cold longitudinal joint.

The surface course—four centimeters (1.57 inches) thick—was placed in a similar manner to a width of eight meters (26.24 feet) and was feathered out to cover the binder course shoulder pavement to an additional width of thirty centimeters (11.81 inches).

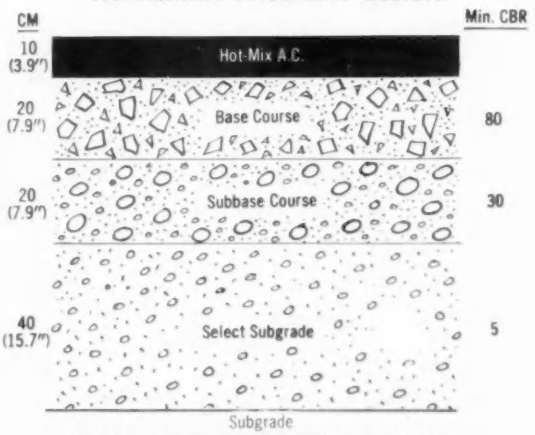
Breakdown rolling was done with a three-wheeler, followed by pneumatic rolling and three-wheel tandem finishing. A thin oil emulsion on the pneumatic wheels virtually eliminated pick-up of the hot mixture by the tires and enabled all the rollers to operate at optimum time and temperature. Constant straight-edge checking, with corrections as needed, produced a smooth riding surface. General appearance of the finished pavement was excellent and the surface texture provides high skid resistance.

Two phases of the Yamashina job deserve special mention. The engineering, inspection and control testing were thorough and detailed from subgrade preparation to the final clean-up, with corrective measures taken as required. And not only did the contractor cooperate fully in matters covered by the contract, but undertook measures beyond those required by the specifications to assure close control and high standards of workmanship. The result was a stable, uniform, durable hot-mix asphalt pavement on a sturdy base, subbase and subgrade.

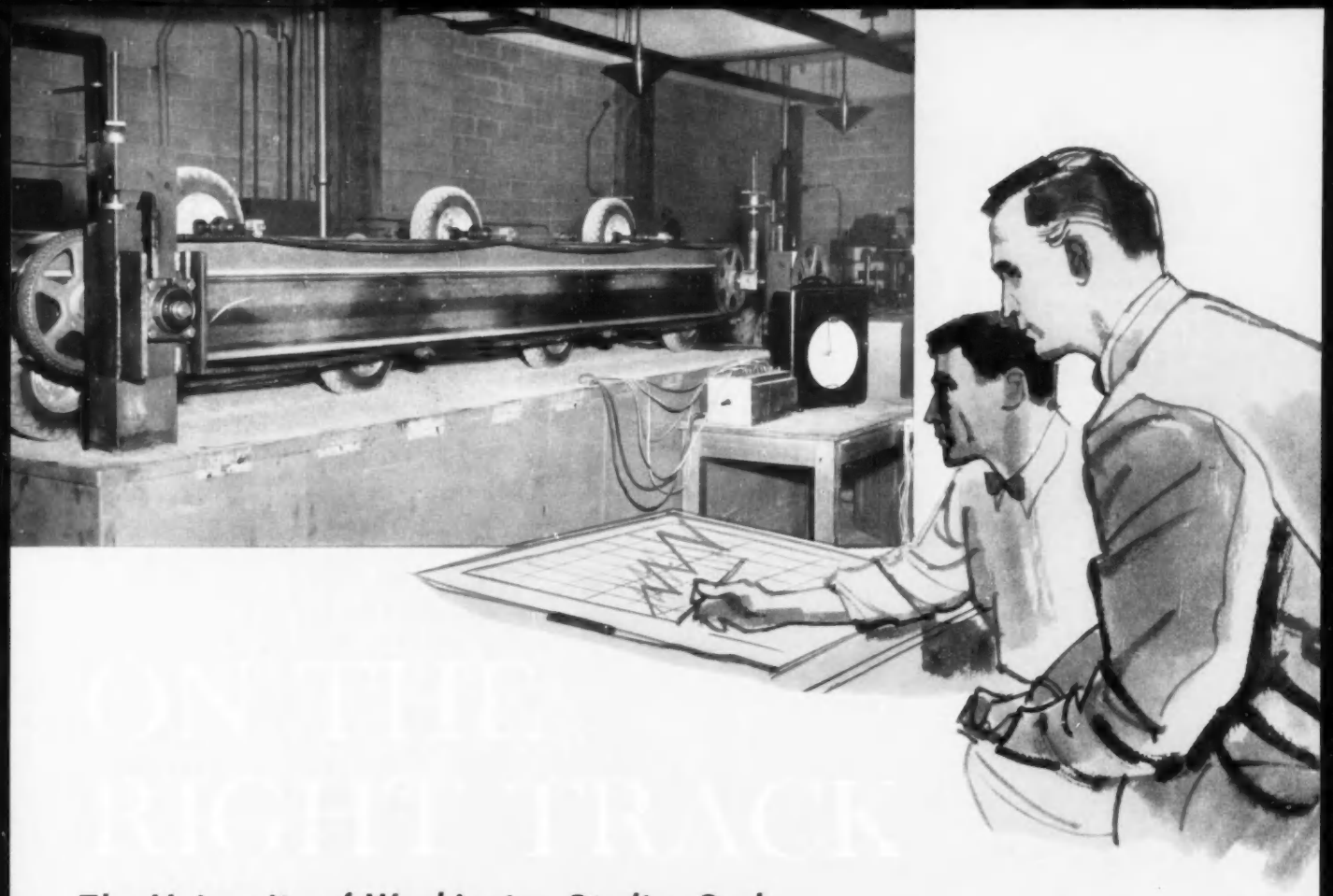
And with the Japanese flair for the ceremonial, the successful completion of the Yamashina Project wound up on a party note with three Kodan laboratory girls getting all dolled up in kimono (plural of kimona, please) and posing prettily for pictures in the sculptured gardens of Kyoto.

**Section of finished road. Japanese are not left-handed drivers, like the British, but the author's Japanese driver volunteered to put a little life into a picture of a road not yet opened**

**YAMASHINA PAVEMENT DESIGN**




(CBR determined at 95% of modified Proctor density)



# *The University of Washington Studies Seek Gravel Equivalence of ASPHALT CONCRETE*

**by Martin Ekse**

During the past several years, a series of research projects has been conducted by the Civil Engineering Department at the University of Washington, using a laboratory model test track, in an attempt to evaluate the flexural strength of asphaltic paving mats. Closely related studies have been made to determine the effects of various kinds and amounts of mineral filler on flexural strength and temperature susceptibility. This work has been subsidized by a grant-in-aid of $1500 annually from The Asphalt Institute.

The test track consists of seven wheel-and-axle assemblies and a refrigeration tank, about twelve feet long and three feet square in cross-section, in which soil subgrade and pavement sections are built. Soil is placed in the tank under carefully controlled conditions of moisture and density. Calibrated pressure cells then are placed flush with the subgrade surface with a covering of sand to assure uniform pressure on each cell. Finally, a pavement structure, composed of crushed gravel base course and an asphalt concrete mat, is placed on the subgrade.

Each wheel-and-axle assembly is calibrated to establish definite contact area, tire pressure and wheel loads. Loads are brought onto the wheels through compression springs at the corners of the tank, and the operating speed of the wheels ranges from zero up to five feet per second.

Tests conducted on the University of Washington's laboratory model track during the last several years clearly indicate that we may establish a "gravel equivalence" for asphalt concrete pavement, by which the flexural strength of such pavement may be evaluated and applied in design.

Further, the accumulated evidence supports a growing body of engineering opinion urging thicker asphalt paving mats and the use of asphalt-treated base courses for the heavy-duty construction needed for today's highway and airport pavements.

## MINERAL FILLER ROLE

Finally, our tests are confirming that mineral fillers play an important role in providing greater stability and flexural strength in asphalt paving mats and asphalt-treated bases. And these fillers tend to preserve this stability and strength through a greater temperature range.

It's interesting, too, to reflect on the special advantage of thicker asphalt mats and asphalt-treated base construction. The reduction in the over-all required thickness of the pavement structure means a substantial saving in road-building aggregates—already in critically short supply in some areas, especially at or near the construction site.

Employing special apparatus (described in the adjoining column), an extensive series of tests were made on asphalt

concrete paving mats with Marshall stability values in the range of 1,800 to 2,400 pounds and flow values of from ten to fifteen. The paving mats (compacted to 93-95 percent of theoretical maximum density) varied in thickness from zero to four inches, placed on a gravel base so the total structural pavement thickness was maintained at a constant six inches for better control of wheel loading.

Wheel loads of 500 pounds were operated over the surface at a speed of about three feet per second, with tire pressure at forty pounds per square inch. The loading was continued until pressure readings, as indicated by the buried pressure cells, became stabilized. Then recordings were made of the pressure intensity at each cell.

Typical results are shown in Figure 2. Note that the maximum pressure intensity on the subgrade using a three-inch mat and three inches of base course is about one-half the maximum pressure intensity using six inches of base course with no asphalt mat. A four-inch paving mat with two inches of base course made an almost uniform distribution of pressure intensity on the subgrade, but it was not possible to increase the wheel load sufficiently to get a good measure of flexural strength of this thickness of paving mat. However, the data demonstrates effectively that the paving mat spreads the wheel load over a greater supporting area of the soil.

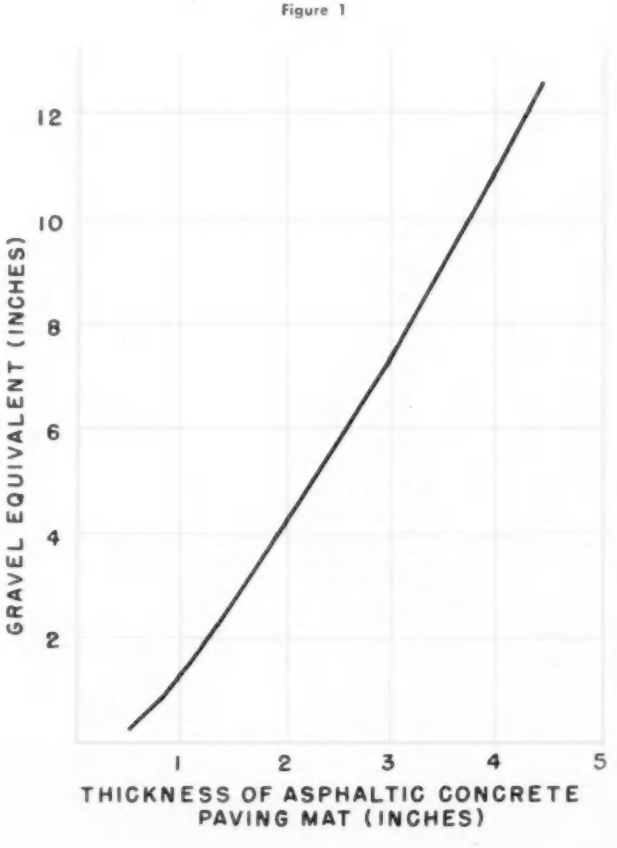
The considerable data derived from these tests series made it possible to express the strength (or load-carrying capacity) of an asphalt paving mat in terms of a "gravel equivalent." For example, a two-inch mat is as effective as four and one-half inches of crushed gravel base course in distributing a moving wheel load on the subgrade soil, producing the same maximum pressure intensity on the soil. Similarly, a three-inch mat was shown to be the equivalent of about seven and one-half inches of gravel base—and a one-inch paving mat produced the equivalence in flexural strength of about one and one-half inches of crushed gravel base course.

It will be recalled that the WASHO Road Test of several years ago (See January 1956 *Quarterly*) demonstrated that pavements with four inches of asphalt concrete surface have a load-bearing capacity equal to pavements ranging from four to nine inches in greater overall thickness but where only two inches of asphalt concrete surface were used. Using a median value of six and one-half inches of reduced thickness of gravel base, and adding the four and one-half inches of gravel equiv-

## About the Author

Martin Ekse is professor of Civil Engineering at the University of Washington where he has been a member of this department since 1948. In this time his principal research interests have been in the field of highway materials and in studies related to highway cost allocation. Prior to 1948, Professor Ekse spent nine years with the South Dakota State Highway Department and two years with the United States Soils Conservation Service in that state.

Figure 1



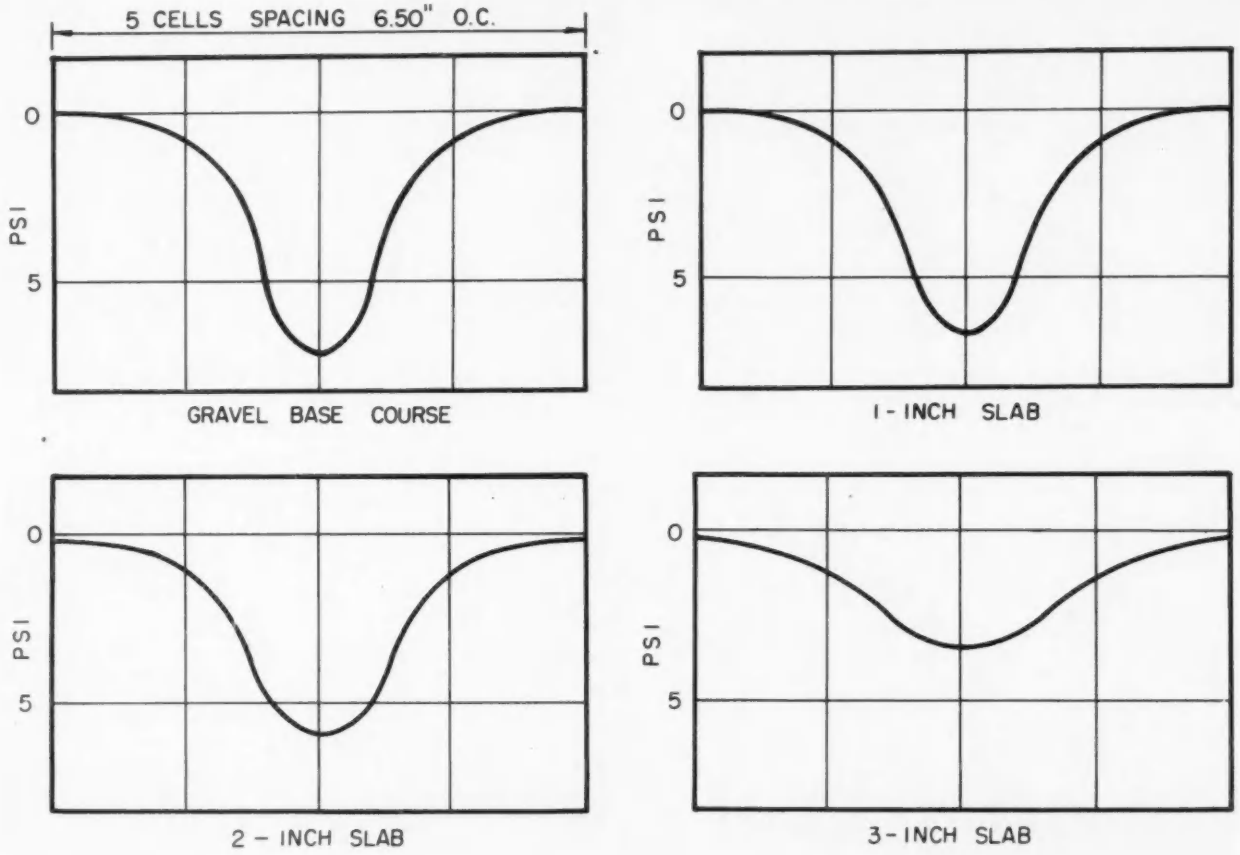



**Figure 2**
**Pressure distribution under 500-pound load as affected by slab thickness, temperature at 70° F.**

alence for the two-inch surfacing, we arrive at a calculation that the four-inch asphalt paving mat has a gravel equivalence of about eleven inches. These data are plotted in Figure 1.

The relationship shown in Figure 1 is necessarily tentative since the results are based primarily on laboratory testing with limited wheel loading. Findings from the recently completed AASHO Road Test may verify and/or modify the laboratory test track data and help in establishing an evaluation of the comparative load-carrying capacities of the thicker paving mats.)

We may draw up a table of gravel equivalents that will look something like this:

1" asphalt concrete = 1½" crushed gravel
2" asphalt concrete = 4½" crushed gravel
3" asphalt concrete = 7½" crushed gravel
4" asphalt concrete = 11½" crushed gravel

## MINERAL FILLER EFFECTS

Further studies at the University of Washington and elsewhere have shown that mineral filler used in asphalt concrete mixes is effective in increasing the flexural strength of the paving mat and in reducing temperature susceptibility of the mix. Test results indicate that the optimum filler-asphalt ratio for both limestone dust and portland cement is in the range of 1.25 to 1.75 by weight.

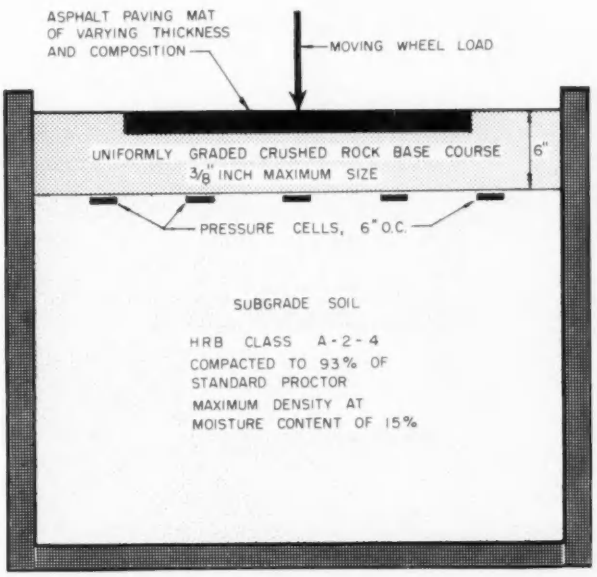



**Figure 3**
**Cross section of laboratory highway test track showing general scheme of installation**

# BLACK BASE IN BADGERLAND

Twin ribbons of asphalt concrete will give Wisconsin motorists smoothest ride; asphalt base will give them years and years of easy-on-the-wallet maintenance

## AGGREGATE GRADATION REQUIREMENTS

(BINDER COURSE)

| Sieve Size | Percentage by Weight Passing Specifications | Job Mix |
|---|---|---|
| 1¼ inch | 100 | 100 |
| 1 inch | 95-100 | 100 |
| ½ inch | 65-90 | 74 |
| ⅜ inch | 55-80 | 67 |
| No. 4 | 40-65 | 51 |
| No. 10 | 25-50 | 39 |
| No. 40 | 10-30 | 23 |
| No. 200 | 3-12 | 9.2 |
| AC Content (85-100 pen.) | | 4.4-4.9% |

(SURFACE COURSE)

| Sieve Size | Percentage by Weight Passing Specifications | Job Mix |
|---|---|---|
| ¾ inch | 100 | 100 |
| ½ inch | 95-100 | 98 |
| ⅜ inch | 75-100 | 89 |
| No. 4 | 45-85 | 68 |
| No. 10 | 30-55 | 51 |
| No. 40 | 15-35 | 29 |
| No. 80 | 10-25 | 17 |
| No. 200 | 5-12 | 8.9 |

Contractors took special pride in this project, first asphalt-paved segment of Wisconsin's Interstate system

Four inches of asphalt concrete base with three inches of binder and surface course was the engineer's design

Slicing diagonally across the midriff of Wisconsin are two Interstate-Defense highways which, together, seem destined to form one of the busiest and most vital transportation links in the upper Midwest. When completed, one of them—I-94—will connect the metropolis of Milwaukee with Minneapolis and St. Paul. The other—I-90—pushes northwestward out of Chicago, through Madison and on to within a few miles of the sprightly little city of Tomah before veering west across the Great Plains and the Rockies.

Between Madison and Tomah the two routes overlap, forging one mainline artery to channel the critical flow of traffic between Minnesota's Twin Cities and those mighty hubs of Great Lakes commerce, Chicago and Milwaukee.

It was almost in the exact geographic center of this overlapping segment that the Wisconsin Highway Commission in 1960 chose to build its first section of asphalt-paved interstate mileage.

## CARRIES VACATIONISTS

Just a few miles west of the one-time Indian trading post of Portage, the slopes of the Baraboo Range spill over into a long green valley patched with brown corduroy fields.

Last month interstate travelers and late-season vacationers bound for the storied resorts of Wisconsin Dells streamed through the scenic valley for the first time on a 12.2-mile stretch of asphalt-paved four-lane divided highway.

Paralleling U. S. Highway 16 across the river, this newest leg of Interstate 90-94 now links State Highway 33 with U. S. 12 at Lake Delton. Since it was awarded to contract more than a year ago, members of the Wisconsin Bituminous Paving Association and other asphalt supporters have kept an eager eye on the project, hoping it will prove the forerunner of many more miles of asphalt pavement on the Wisconsin Interstate.

Certainly the three major contractors—Highway Pavers of Wauwatosa, Mathy Construction Company of LaCrosse and White Construction Company of Milwaukee, all members of the Wisconsin BPA—have mothered its construction with prideful care.

## 24-INCH PAVEMENT

Designed for heavy-duty service across low-lying sections of glacial sands and occasional swatches of muckland, the pavement measures 24 inches from subbase to surface. Full use was made of locally available aggregates.

The base course consists of twelve inches of gravel or crushed stone, six inches of which were treated with portland cement. Next came four inches of asphalt concrete base, topped off with three inches of asphalt binder and surface course. All sections utilized full-width construction with asphalt-paved shoulders.

Standard density and optimum water content were determined for each soil type encountered or used and compacted to at least 95 percent of maximum standard density (AASHO T-99).

## SUBGRADE TEST-ROLLED

The subgrade was test-rolled with not less than two nor more than four passes of a 20- to 40-ton pneumatic-tired roller carrying tire pressures of 60-90 pounds psi. In the event any yielding or soft spots developed, they were repaired and made firm before additional lifts of embankment were added.

The top five inches of all embankments and the 5-inch backfill of cuts were constructed of granular materials selected from the roadway or borrow excavation.

Sand or a mixture of sand and gravel was used for the 5-inch subbase. Specifications required that all material pass a 3-inch ring, and that the liquid limit not exceed 25 nor the plasticity index 6.

The 6-inch untreated base course was constructed in the conventional manner with carefully graded aggregates compacted to 95 percent of standard density in layers of approximate equal thickness. Rubber-tired and vibrating compactors were used in the consolidation.

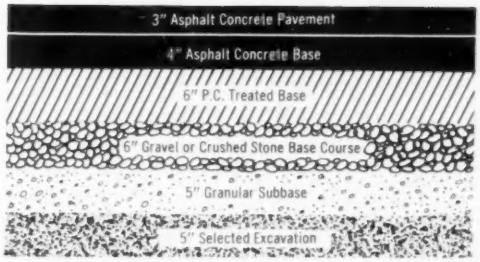
The top six inches of aggregate base were treated with 2.5 to 3 percent by volume of portland cement, using Seaman or P. & H. single-pass stabilizers. After compaction (95 percent of modified Proctor density), 0.25 gallon psy of RC-2 prime was applied to cure the base.

## ASPHALT BASE COURSE

For the asphalt concrete base, engineers specified a coarse graded, hot-mix having the following gradation requirements:

| | *Percentage by Weight Passing* | |
|---|---|---|
| *Sieve Size* | *Specification* | *Job Mix* |
| 1½ inch | 100 | 100 |
| 1 inch | 75-100 | 94 |
| ¾ inch | 60-85 | 81 |
| ⅜ inch | 40-65 | 61 |
| No. 4 | 30-55 | 45 |
| No. 10 | 15-35 | 33 |
| No. 40 | 5-20 | 15 |
| No. 200 | 0-5 | 3.3 |
| AC content | (85-100 pen.) | 3.0 |

Two lifts of 2-inch compacted asphalt base were laid and compacted to a minimum of 90 percent of maximum theoretical density. Breakdown rolling was done with 8- to 10-ton tandem or three-wheel steel rollers, and final rolling carried


3" Asphalt Concrete Pavement
4" Asphalt Concrete Base
6" P.C. Treated Base
6" Gravel or Crushed Stone Base Course
5" Granular Subbase
5" Selected Excavation

out with an 8- to 12-ton tandem roller.

Binder and surface course mixtures were the conventional mixes used in hot-mix paving in Wisconsin. Gradation specifications for both mixes are shown in the accompanying tables.

## PAVED SHOULDERS

Shoulders of the new interstate section were paved with 2.75 inches of hot-mix for a width of seven feet on the outside and three feet on the inside shoulder. Binder and surface course mixes were identical to those used on the pavement, except that a 120-150 penetration asphalt was used. Shoulders were topped with a quarter-inch chip seal for traffic delineation.

In all, pavement contractors on the 12-mile roadway used nearly 79,000 tons of hot-mix asphalt base and more than 80,000 tons on the binder and surface course.

An extensive experimental stretch of asbestos-in-asphalt paving was placed not long ago in the State of Delaware

On Atlanta job, roller could work directly behind the paver

# ACCENT ON

## *New Surge of Interest in Role of Mineral Filler*

WHEN the research-minded engineers of the Atlanta Department of Public Works decided last year to lay a test strip of asphalt pavement containing asbestos filler, they knew exactly what they were looking for. It was a design which would produce tougher pavements with added weather resistancy, greater flexural strength and long-term stability at high temperatures and under severe traffic conditions.

They knew also that if the asbestos-asphalt mix was to give them any kind of meaningful answers—positive or negative—it should be field-tested in the hottest traffic spot the city had to offer.

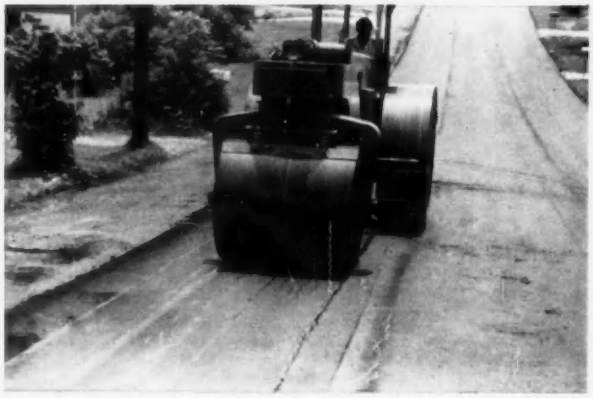
### TRAFFIC HOT SPOT

Construction Chief Ray A. Nixon and Maintenance Engineer Dan Johnson put their heads together on the matter and settled on one of the busiest feeder lanes in Atlanta: the two-block stretch of downtown Courtland Street connecting Harris Street with the off-ramp of the traffic-laden North Expressway. Since Courtland was a two-way thoroughfare, they decided to lay three 2000-foot-long test sections: a 16-foot center strip of asbestos-asphalt sandwiched between eight-foot ribbons of conventional asphalt. All three pavements consisted of a one-inch binder course topped by a one-inch overlay, and all contained the same aggregate gradation. However, the center strip was designed for 2.5 percent of short asbestos fiber and 7.4 percent asphalt cement, an amount of asphalt previously considered dangerously high for the standard city mix.

With these test strips under constant surveillance, Nixon and Johnson reasoned that three years of typical Courtland Street traffic would provide a bumper crop of data.

What they didn't expect, however, was the development of some rather remarkable clues even before the paving was completed. These stemmed from an acute problem which wasn't exactly anticipated. As construction got underway, traffic at the spot turned out to be so heavy it was virtually impossible to keep vehicles off the pavement. Suddenly city crews found themselves involved in an unexpected test of performance and speed in putting a road back into service.

In laying conventional pavement, the crews had standing instructions to hold traffic off the rolled surface for an hour minimum. But Nixon and Johnson noted right off the bat that the asbestos-asphalt mix reacted differently.



**A 10-ton roller is shown parked on the still-warm pavement. The roller was left there for about ten minutes with no visible evidence of damage.**

**To relieve a serious case of congestion, engineers on the Atlanta project decided to admit traffic to the new surface less than an hour after paving.**

# ASBESTOS

First, they found the breakdown rolling could be moved up closer to the paver without any perceptible blistering or tearing. Second, they noticed a 10-ton roller, stopping for nearly 10 minutes on a 20-degree grade while the mix was still hot, left no evidence of pavement distress.

## OPENED TO TRAFFIC QUICKLY

With traffic piling up at an unnerving rate, they decided to take what military men called a "calculated risk." Twenty minutes after initial rolling, the center test strip was thrown open to full traffic. No damage resulted.

The Atlanta installation is not unique. During the past three years some 60 field sections have been placed in U. S. and Canada to test asbestos-in-asphalt under the harsh realities of varying support conditions, weather and day-to-day traffic. Intensive laboratory research is continuing at half a dozen levels of interest.

All this speculative concern has lent brand-new emphasis to a material that has been kicking around the civilized world for more than twenty centuries. The word "asbestos" was coined by the ancient Greeks to identify a fabulous stone

## CALIFORNIA JOINT RESEARCH PROJECT WELL INSTRUMENTED

AS this issue of the *Quarterly* was going to press, construction was scheduled on an experimental asbestos-asphalt installation of more than casual interest to the engineering world.

Focusing their attention for the moment on a short strip of pavement in Contra Costa County, California, were engineers representing The Asphalt Institute, Johns-Manville, California Division of Highways, University of California, Contra Costa County and the City of Martinez. Why? Because the 2700-foot test section represents the most heavily instrumented experimental plot ever installed to make a critical examination of a paving mixture using asbestos fibers for mineral filler.

Project site is Shell Avenue, a short stretch of city-county pavement leading to the large Shell Oil Company refinery. Because of the location of the road, with virtually a controlled flow of truck traffic, it is ideally suited to the test.

Construction consists of a 3-inch overlay, using a California Division of Highways Type B (¾-inch maximum) paving mix (same as the Asphalt Institute Type 4-B mix.) There are four test panels of the dense-graded mixture, designed with and without the short asbestos fibers for mineral filler. Two penetration grades of asphalt cement (85-100 and 40-50) are being used. One section control used an 85-100 penetration grade asphalt (5.5 percent by total weight of mix) without asbestos filler. The alternate section was designed to include 2.5 percent (by total weight) of Grade 7-M06 short asbestos fiber and 6.3 percent asphalt. Matching sections, using a 40-50 penetration grade asphalt cement, have been designed with and without asbestos filler—again with increased asphalt content in both the control (non-asbestos) mix and the asbestos-asphalt mixture.

Instrumentation, under the direct supervision of Professor C. L. Monismith of the University of California, includes SR-4 strain gages in each test section to measure the deflection strain, and a 6-channel Sanborn recorder. Small temperature sensing elements, placed at various levels in the pavement, are to be used to control rolling operations and correct for temperature variations during deflection studies. A 5-year schedule of sampling and testing has been set up with each of the several contributing agencies assigned special roles. In addition, deflection gages were installed to measure pavement deflections under transient loads.

The purpose of the experimental work is to determine the extent to which asbestos may contribute to any of the following:

1. Increased durability and weatherability with a consequent decrease in maintenance costs. (Greater cohesion in the binder and heavier mastic coatings of the aggregate particles are said to produce a corresponding increase in pavement toughness. Also, the increase in asphalt cement which the asbestos mix will tolerate results in a denser, tighter mix with a higher degree of impermeability, and the richer mixture is expected to reduce the brittleness of the pavement in cold weather, giving it greater impact strength at low temperatures.)
2. Increased flexural strength and greater flexibility.
3. Increased long-term stability.

which when set on fire could not be quenched. But the whole effort has to be scored as a goose-egg for the Greeks. Their stone turned out to be quick-lime, and the name asbestos ended up belonging to a mineral that will scarcely burn at all.

## ASBESTOS FILLER NOT NEW

The modern asbestos industry began in 1868, and long before World War I the strange fibrous silicate had become an integral part of the construction trades. The cohesive qualities of asbestos and asphalt have been utilized for years in roofing and joint-sealing. Asbestos even figured in the controversial hot-mix paving patents of the twenties and early thirties. However, as a paving ingredient, not much came of it until the severe demands of today's heavy-duty, channelized traffic and high tire pressures focused attention again on the role of mineral fillers in bituminous mix designs.

With justifiable enthusiasm (as producers of a third of the world's output) the Johns-Manville Corporation is pressing the new research drive on asbestos in pavements. The company's interest was stimulated more or less by accident in 1953 when one section of a steep road leading into its big Jeffery Mine in southern Quebec was resurfaced with asphalt containing a modest amount of short asbestos fiber. Mine engineers were particularly impressed with how well the new surface resisted abrasion and "shoving" under the daily braking and climbing of heavy ore trucks. Word of the new pavement's performance sifted back to the front office in New York, and a research team was dispatched to check into the matter. The result was the launching of a full-scale laboratory test program.

After nearly four years of concentrated research, Johns-Manville engineers are convinced that asphalt and asbestos have a physio-chemical affinity which lends some remarkable new properties to bituminous mixes.

First, they claim, the addition of one to three percent of asbestos fiber will allow the use of substantially more asphalt in a mix without the danger of bleeding or flushing.

This in turn, they believe, gives the pavement:

1. *Increased flexibility and at the same time greater flexural strength and durability.*
2. *A greater resistancy to densification, which would help prevent rutting and tracking.*
3. *Increased impermeability resulting from the higher asphalt content.*

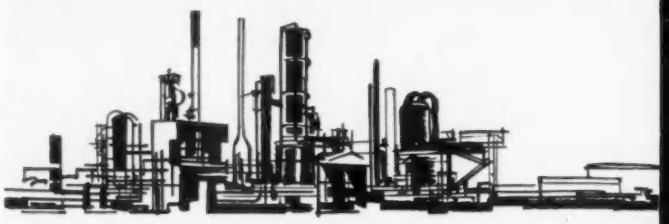
Since 1958, other agencies and groups, notably The Asphalt Institute, have also devoted a great deal of laboratory exploration to asbestos-in-asphalt along with a great variety of other mineral fillers. Understandably they apply a more cautious interpretation to their findings.

## ENGINEERS CAUTIOUS

Says one highly-qualified research engineer who has conducted much of the basic laboratory work on asbestos fillers:

"We know that asbestos—and for that matter other mineral fillers—induces immediate and pronounced property changes in asphalt mixes which improve their mechanical behavior. But it remains to be seen whether or not these changes will sustain with time."

That is the big question. With 60 field tests now underway, the answer may be close at hand.



# ASPHALTOPICS

*Continued from page 3*

***WE'S REGUSTED***—**And speaking of the July issue, we had a dandy story about how the *Orange County (California) Flood Control District* paved the Santa Ana River revetment with asphalt—then stuck a headline on it giving full credit for the work to the *Los Angeles Flood Control District.* Makes us wonder sometimes why we didn't stick to quahogging . . .**

* * *

**PUTT-PUTT NOTE**: Some time ago we were tipped that the Age of the Electric Caddie Cart had brought in its train a network of asphalt-paved cart paths across the golf courses of America. We've tried to run this down but the story doesn't seem to jell. A few courses have a few paths and others have installed parking pads for these buzz-buggies to save wear and tear on the grass and turf. But the only major installation seems to be at George May's Tam O'Shanter club in Chicago. George, who introduced the jackpot payoff to golf tournaments before Las Vegas got into the act and who abhors sloppy business practices of any kind, tells us that he has installed some 8,000 linear feet of paved walks at his layout in the last two years. He has 125 carts operating at Tam (where players are required to use them—to speed play).

**Asphalt-paved paths for electric caddie carts are being adopted as turf savers by smart golf course managers. Here is a view of the beautiful Pine Needles Golf Club at Southern Pines, N.C., owned and operated by Warren and Peggy (Kirk) Bell. She is the popular tournament pro.**

* * *

***THE MORE'S THE PITHY***—*Bernard Gray, the Sage of Sarasota, recalls one of the most effective "papers" he ever heard delivered by an engineer. It was at one of the very early road schools for county engineers, one of whom addressed his colleagues as follows: "The subject of my talk is drainage. Drainage is the taking of water off the top of the road before it can do any harm. Anybody in the road business who don't pay attention to drainage will never amount to much. Thank you." Bernard reports there was a stunned silence for a moment, than the entire audience came to its feet, applauding.*

* * *

**DER SHREG WAG**—Historian Bertha Louise Goetsch of Cleveland is frantic to complete the who-what-when-and-where on the old "Army Road" (or "Kenton and Kalida Road," or the "Schifferly Road") which slants southeast from Kalida, Ohio, to Kenton. Only a small stretch of the road still exists, known as "Schifferly Road" and, in the meantime, the courthouse at Kalida burned down many years ago with all the records. Mrs. Goetsch's research has reached a dead end. (Even a search in the Library of Congress only turned up a corner of a 1790 map on which some surveyor had jotted down a recipe for making beer!) Can any of our readers help Mrs. Goetsch?

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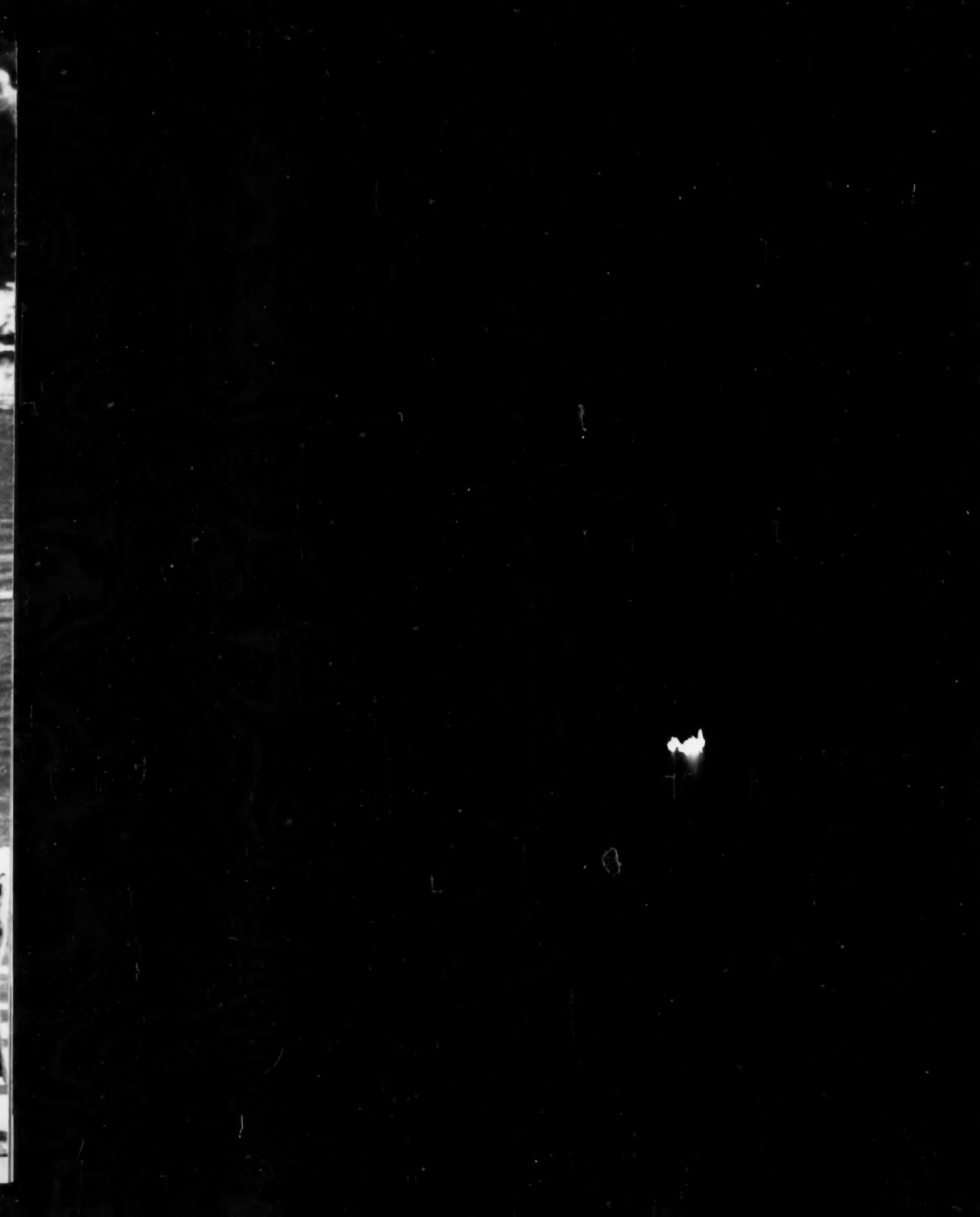
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